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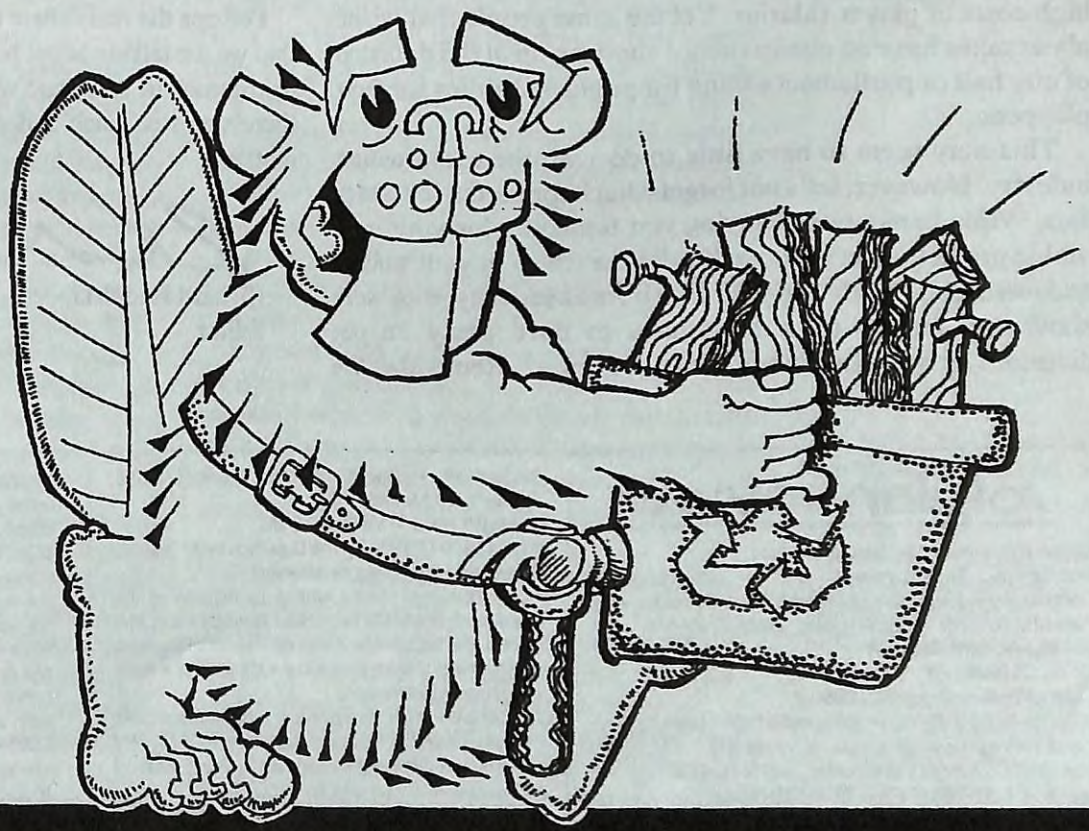
Re-using Materials



From the Editor . . .

Have you noticed that, although there is no inflation, you are paying more for your supplies? Isn't it interesting that the prices of all kinds of construction materials move one way only – up? And that is regardless the level of construction activity.

The laws of the free market, where supply and demand are supposed to keep excessive price gouging in check, no longer seem to work. In our globalized economy, events on the other side of the world can determine prices here. Then again, when there is an over concentration in any one industry, there is not much competition.

Whining about tax rates and regulatory burdens is fashionable. So is blaming all problems on public policy. However, corporate shenanigans are probably more at issue today than public policy. The large global corporations that control so much of our economy and building materials production can manipulate monetary and material resources at will, with no accountability.

The same thing goes for some marketing expenses we see thrown around. Professional "sports" fans know about the high costs of player salaries. Yet the same people that whine about taxes have no qualms about showing up at the doorstep of city hall or parliament asking for public subsidies for their playpens.

This may seem to have little to do with the construction industry. However, let's not forget what happened a few years ago. While banks were denying you financing for your very viable project, even if you had sales contracts in your pocket and were ready to give up your first born as security, they were shovelling money on a handshake to third party tin pot dictators or over-ambitious "entrepreneurs". Remember the rise in interest rates after the Latin American meltdown in the 1980's? Or the Olympia and York collapse? When the inevitable happened, who paid? How many points did interest rates rise?

We have to be on guard because the same thing is happening to us now, but in another way. Those multi-million dollar product liability settlements and mega mergers where huge sums of money change hands have to be paid off somehow. Large corporations will inevitably milk their various divisions for all they are worth to raise the necessary cash. Guess what that means? How about price increases at many multiples of inflation or true cost of production? Don't you just wish you could do the same to improve your bottom line?

We may not be able to do anything directly about these activities. Individually we may not have much say in these matters, but as an industry we should remain ever vigilant, and make our voice heard at every opportunity. Maybe accountability rather than mere lip service can become a fact of life at some time in the future.

Perhaps the real debate no one is willing to enter into is that we are talking about how we manage development and distribution of economic well being. It's not so much that there's no free lunch, but who gets stuck with the bill that matters.

Richard Kadulski,
Editor

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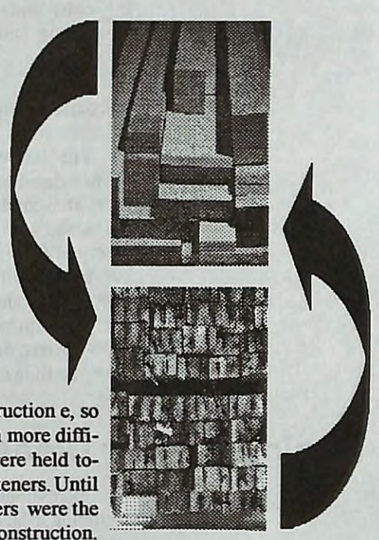
Re-using Building Materials



Not that long ago anything used was considered junk, or at best, second rate. Those who collected used materials for possible reuse were thought of as junk collectors, not taken seriously, and rated a low social standing. However, over the past few years, concerns about the volumes of waste going to landfill, resource exploitation, pollution, and increasing costs have turned the salvage business into a respectable industrial sector.

The used building material industry has experienced rapid growth in North America over the last five years. Today, it encompasses private, for profit and private non-profit organizations in the reuse and recycle business. It even has its own trade association: the Used Building Materials Association.

Barriers to Recycling

Despite the good will toward recycling, many standards, codes and rules in the industry function as barriers to the collection and redistribution of salvaged building products.

While there is no shortage of people searching out good-quality used building materials, the industry's main challenge is finding inventory and supplying it at a profitable price. Regulatory barriers include the inconsistent application of the building code, water-and energy-conservation regulations, contamination as well as inadequate Workers' Compensation classifications and private insurance coverage. All these affect the economic viability of many materials reclamation projects.

Structural engineers and building authorities look for a grading stamp on all structural lumber, but methods for grading used lumber have only just begun to be developed. Visual grading for reclaimed timber is difficult because the timber might contain internal decay, insect damage or have a painted surface. However, much used timbers was originally cut from old-growth forests and has higher density, fewer knots, and is of better quality than currently produced lumber.

Regulatory barriers may decrease the economic viability of reselling used building materials if there is a risk of contamination. For example, asbestos, lead paint on windows and doors, PCB in light-fixture ballasts, and treated lumber are all commonly found on the demolition and renovation job site. Regulations requiring the removal of lead paint create higher labour costs that can reduce the profitability of reclaiming. Other barriers include modern fastening practices, rapid demolition, tipping fees, inventory timing and financing.

Construction practices themselves can create problems. At the design stage and when building, we focus on durability and strength because we do not plan for deconstruction e, so we may make future recycling even more difficult. Older buildings and homes were held together by nails, screws and other fasteners. Until the mid-1950s, these simple fasteners were the main types used in wood-frame construction. Since the 1950s, the development of new power tools and power-nailers has limited the profitable reuse of wood components. In addition, the use of fasteners such as glue and staples, limits the potential for salvaging material. Although these fasteners outperform their predecessors, they make salvage much more difficult.

Sometime in the future, this may be thought of as the construction industry's version of the Y2K problem.

Since the 1950s, there has also been a change in the types of materials used, from solid materials to composite engineered wood materials for sheathing, sub flooring and cabinetry. These surfaces, if attached with glue, staples or power-nailers, are almost impossible to salvage in good condition.

Other job-site practices that complicate material reclamation include:

- nailing rather than screwing door and window jams to rough stud openings, which requires a more damaging prying motion to remove;
- nailing rather than screwing steel enamelled bathtubs to wall studs over the mounting flange;
- using flathead rather than Robertson screws in hinge hardware;

***"Increasing the Volume of Used Building Materials in Canadian Construction: A Report to Assist Homeowners, Contractors, Building Officials and Operators of Used Building Material Centres in Canada"* by Bob Sawatsky, ReUze Building Centre Scarborough, ON and Jennifer Corson, Renovator's Resource Inc., Halifax, NS for the Research Division CMHC**

- using a compression nailer with the power setting too high, resulting in the nail being set too deeply (and prying apart even more difficult); and
- using caulking to seal storm windows to frames.

Reclaming Lumber

The following factors should be considered when deciding whether to dismantle a structure:

- the condition, dimensions and species of wood;
- the type and number of fasteners per wood member;
- where the lumber is used in the building (beneath layers of flooring, and so on);
- the cost of labour;
- the time allowed for dismantling a building;
- the building height and site configuration; and
- the time allowed to store material on the site.

The time required to fully dismantle a wood-frame building is about four to five times longer than traditional demolition. This is due to several reasons:

- dismantling is done mostly by hand, without large equipment;
- components must be carefully removed in large, unsplit units from the building;
- the material must be processed on-site before transportation (i.e., de-nailing)
- the material must be carefully packed for transportation;

Unfortunately, most building owners lack the time and interest to consider reclamation when they face a deconstruction project.☼

Designing For Disassembly

Increasingly, automobiles and appliances are beginning to be designed with disassembly at the end of their life in mind. Disassembly should also be a consideration during the design phase of a home, rather than simply in the middle (renovation) or at the end of its life cycle (during demolition).

Although deconstruction is gaining popularity by showing that used building materials can be reused or recycled, its practice and cost-effectiveness is still viewed with skepticism. A major contribution to the labour intensity of salvaging used building materials is the way in which homes have traditionally been built. Traditional design and construction give no consideration to the eventuality of renovation. As a result assemblies, components and building systems are joined, fastened and connected in a manner which makes disassembly difficult and wasteful.

The challenge for our industry is to develop details that will ensure durable, energy efficient, draft-free construction over the desired life time of the building, yet allow disassembly when required.

Factors that contribute to reusable or recyclable materials being disposed of in landfills include the status of local reuse and recycling markets, hauling and tipping fees, landfill material bans, workforce sensitivity to waste reduction issues, degree of on-site source separation effort and enforcement, the price of new materials and project scheduling.

Designing For Disassembly, by Vince Catalli, dEsign consultants for the Research Divison, CMHC

Obstacles to Disassembly

A review of typical renovation waste in traditional design provides the following examples of disassembly obstacles.

Foundations

The lack of modularity of cast-in-place concrete makes it impossible to adapt, disassemble or reuse for the same purpose. While cast-in-place concrete is not reusable in its original form, it can be crushed and recycled as inert fill material or as granular sub-base.

Framing

Dimensional lumber can be reused if salvaged in good condition.

Wood wall and floor framing is typically fastened with nails, making disassembly difficult.

Subfloors are typically glued to floor joists to prevent separation and inhibit squeaking. This makes its salvage for reuse or recycling difficult.

If quantities warrant, other recycling possibilities for framing lumber include: feedstock for oriented strand board; animal bedding; landscaping; absorbent for oil spills; raw fuel source, and as a bulking agent in composting operations.

Roof framing is generally not a waste issue due to the fact that pre-manufactured trusses arrive on site complete and ready for installation.

Strapping and fascia boards can be salvaged for reuse or recycling.

Plywood and particleboard sheathing as underlay are both reusable if they are removed carefully and in good condition. Their recyclability may be restricted by the presence of finish materials and adhesives.

Interior Finishes

Drywall panels are rarely salvageable in a condition suitable for reuse. Drywall joints are typically taped and plastered to conceal seams. This makes locating joints difficult and salvage of reusable boards virtually impossible.

Vinyl is recyclable, but glue contamination limits its acceptance. Vinyl sheet flooring is typically adhered to underlay with large quantities of glue making the finished flooring difficult to remove. As a result the vinyl and underlay are rarely reusable.

Thermal & Moisture Protection

Polyethylene vapour barrier joints are typically sealed with caulking, making salvage of the material for recycling a messy and labourious task. Drainage layers installed to enhance foundation wall dampproofing are typically fastened with asphalt compound, so the material is not considered salvageable.

Brick veneer is typically constructed with mortar, making disassembly a labourious and potentially wasteful process, although used brick does have a market. Old brick can be separated from mortar and reused on-site or in the construction of chimneys and fireplaces. If not reusable, brick can be crushed and recycled as inert fill or as landscaping top cover.

Asphalt shingles are typically fastened to roof sheathing using nails. If the shingles are brittle or have bonded together, disassembly is difficult. Attempts to salvage shingles in reusable condition is a labourious task which is hindered by the brittle state of older shingles as well as the way in which shingles bond together over time. Many road construction companies now accept used shingles for use in the manufacture of asphalt paving material.

Because insulation batts are not mechanically fastened to other building materials, and one easy to salvage. Batt insulation is reusable if it is dry. Shredded batt insulation is recyclable as blown insulation.

Basic Principles of Designing for Disassembly

Design for versatility, allowing a component, assembly or system to accommodate different uses with little change.

Design for durability to allow a material to remain unchanged over its expected life.

Consider planning for easy access, to allow components to be serviced with minimum damage to other materials.

Favour simplicity of design to reduce the complexity of assembling materials, thus making disassembly easier.

Consider opting for independence of material assemblies from others to allow for minimal damage to adjacent assemblies during their removal, repair and disassembly.

Consider exposing connections wherever possible to facilitate disassembly.

Consider making materials for components with the shortest anticipated life cycle more assessable than those with longer anticipated life cycles.

Examples of details to consider

Foundation

Use of Pre-cast concrete panels which can be reused.

Preserved wood foundation which can be renovated.

Consider the use of a foundation drainage layer which can be fastened mechanically rather than with asphalt compounds to facilitate reuse. Similarly, consider using a fastener other than caulking to seal polyethylene air and vapour barrier joints.

Framing & Sheathing

Reversible connections instead of nails to fasten wood framing. Screws and bolts are reversible and would facilitate disassembly.

Pre-manufactured floor joists which increase allowable clear spans, which reduces connections to beams or load-bearing walls and allows for greater floor space flexibility.

Whenever possible, avoid glueing the subfloor to floor joists. The application of glue to the tops of floor joists is not required by the NBC, but is used as a method of increasing the allowable spacing and clear spans of floor joists.

Consider building the exterior walls, which are most likely to accommodate expansion, with post and beam methods.

Consider leaving finish connections (typically drywall screws) exposed or cover joints with an easily removable seam.

Consider the use of materials which possess an inherent finish (panelling) to avoid painting, wallpapering or vinyl coverings which contaminate drywall and restrict its reusability and recyclability.

Flooring finish which is fastened with reversible connections or which only requires minimal adhesive application.

If head room is not an issue, consider the use of dropped ceilings. Dropped ceiling construction requires minimal mechanical connections, and is therefore easily disassembled. It also allows for easy access to mechanical and electrical runs.

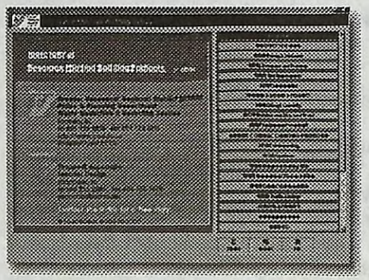
Consider also, the use of weather stripping materials, which are easily removed, rather than adhesive caulking to seal window and door installations.

The reuse of materials is acceptable as long as performance equivalence to new materials can be established under Part 2 of the NBC. Unfortunately, there are few mechanisms in place which promote the establishment of reused building material equivalence.

Because the code's main concerns are for the health and safety of building occupants, the reuse of materials in non-structural assemblies may be easier to meet NBC requirements.

Screws (as a means of fastening structural members) are not currently recognized in NBC, which in the event of their use, necessitates the establishment of equivalence based on the existing nailing tables. ☼

Directory of Resource Efficient Building Products



The Greater Vancouver Regional District (GVRD) has many initiatives aimed at reducing waste disposed in landfill. Publication of the GVRD Directory of Resource Efficient Building Products is one of the latest.

The directory encourages the use of locally available, resource efficient building products. All products listed contain either recycled or salvaged material and/or have been engineered to use raw materials more completely and efficiently, and add value to formerly undesired raw materials or by-products of a manufacturing process.

Entries are organized using the CSI Masterformat and include basic product biographical and descriptive information. Items currently covered include Sitework (Division 2), Woods & Plastics (Div. 6), Thermal & Moisture Protection (Div. 7), Finishes (Div. 9), and Furnishings (Div. 12). Also included is a description of environmental merits, product image and distributor contact information.

Only products readily available in the GVRD are listed. Before being included, products were reviewed according to the following criteria:

- Is the product manufactured in BC or elsewhere in the Pacific Northwest or Canada?
- Are the raw materials acquired close to the manufacturing facility?
- Is waste reduced in the manufacture, packaging and transportation of the product?
- Does using this product reduce waste at the job site?
- Can the product be salvaged, reused, or recycled; or will it be biodegradable when it is no longer used in its original application?

Useful features include a glossary of terms, and suppliers of used building materials.

The content is still a little thin, with many materials missed due to insufficient information at deadline. However, the directory represents an excellent start, will be updated regularly, and likely be put on the web.

The Directory of Resource Efficient Building Products, developed for the GVRD by Penner & Assoc., is available at no cost (to Vancouver area residents) on computer disk from: Greater Vancouver Regional District. Waste Reduction & Recycling Section, Burnaby, BC
Tel: 604-436-6818
Fax: 604-436-6811
www.gvrc.bc.ca
e-mail: tmueller@gvrd.bc.ca

Housing and Building Regulations in the UK

Mark Gorgolewski

The housing industry in the UK has been slow to adapt and innovate, so new technologies and processes, and improved standards have been difficult to establish. Dwellings are responsible for over a quarter of all carbon dioxide emissions in the UK. However, recent government initiatives to deal with global warming have created a climate for change within the building industry, which is now more willing to look at new ideas.

These government initiatives include:

- A review of the thermal insulation requirements of the Building Regulation (codes), which was prompted by the Kyoto commitments to reduce UK carbon dioxide emissions by 12% by 2012. This ongoing process is likely to significantly increase dwelling energy efficiency requirements.
- A government consultation paper to the industry on sustainable construction, entitled "Opportunities for Change", which highlighted issues such as waste reduction, recycling and reuse, and adaptability.
- A government sponsored "Construction Task Force" which has set very challenging targets for improved productivity, efficiency, quality, and reduced costs and defects for the construction industry, and highlighted the benefits of partnering and prefabrication.
- A government sponsored "2000 Homes" programme and "Housing Forum" both of which aim to demonstrate and initiate improved housing quality and reduced costs.
- Government predictions that between 4 and 5 million new dwellings will be required by 2016 (current new construction is about 180,000 units per year) have led to much discussion about where these buildings should be located.
- A government target has been set for at least 60% to be located within existing urban areas, possibly on "brownfield sites". A government sponsored "Urban Task Force" led by the prominent architect Lord Richard Rogers is looking at ways of regenerating urban areas, increasing housing densities and, in particular, maximising the use of "brownfield sites".

An increasing number of builders are beginning to consider how housing can be improved, to examine innovative new ways to produce houses, in particular, opportunities for off-site prefabrication. This process is also driven by a shortage of skilled labour for traditional construction trades.

Currently, the UK Building Regulations for thermal performance are not onerous. The maximum required R-values are R-12.6 (U = 0.45 W/m²K) for walls and R-22 (U = 0.25 W/m²K) for roofs, with little requirement for air-tightness. The calculation of an energy rating (SAP - Standard Assessment Procedure) was introduced as mandatory for new housing in 1995, but no minimum SAP standard was set. Builders can get away with poor performance in one area of a dwelling by offsetting it with improved performance in another area of the same dwelling. Dwellings in the UK are generally smaller than in North America, typically 800 sq.ft to 1600 sq.ft. for a house and 430 sq.ft. to 860 sq.f.t. for an apartment.

The Standard Assessment Procedure (SAP) is an energy rating number between 1 (poor) and 100 (good), and is based on the annual predicted cost of heating and hot water normalized for the floor area. Regulations require that each new dwelling have a SAP rating calculated and submitted to the building official, but no minimum rating need be achieved.

Early last year, the UK government announced a comprehensive review of the thermal requirements in its Building Regulations, to determine the possible contribution the codes can make to reducing UK carbon dioxide emissions. The first phase involved a series of workshops and the publication of a consultation paper that the industry was asked to comment on.

This process received surprisingly strong backing (97% of respondents) by the industry for significant improvements in the Regulations.

The proposals, which were strongly supported and likely to be incorporated in the new codes include:

- A substantial improvement in the building envelope insulation levels, including minimum R-values for walls of R 18 to R 22, and for glazing of R 2.84.
- The introduction of requirements for testing the air-tightness of new dwellings, with a maximum acceptable air change rate.

Mark Gorgolewski is an architect and environmental consultant. He is a National Home Energy Rating (NHER) Assessor and acts as the secretary to the (UK) Steel Sector Environment Committee. He is also on the committee of the Association for Environment Conscious Building and on the Advisory Panel of the "Green Building Digest".

• Widening the scope of the regulations to cover repair and refurbishment of existing buildings.

• The introduction of a regular, mandatory "health check" for buildings, similar to that used to ensure the safety of cars in the UK. This would be done every 5 years or so, or at certain trigger points such as at change of ownership or tenancy, and would set out recommended energy efficiency improvements.

• The introduction of performance indices based on whole-building carbon dioxide emissions, so that dwellings can be compared by their emissions characteristics, and a minimum standard can be set.

• The introduction of new efficiency requirements for building services including heating systems, air conditioning systems (which are growing in popularity in UK housing), mechanical ventilation systems and lighting systems (to encourage the use of compact fluorescent lighting).

• Requirements for the commissioning of building services, and possibly also the introduction of a dwelling "log book" which would be a record of the building's design specification and subsequent maintenance and renovation. (In the UK, cars have log books.)

Currently no air infiltration standard has been suggested. However, UK construction is poor, with typical air change rates for new construction of about 8 air changes per hour at 50 Pascals. (This compares with the average Canadian house at 3.3 ACH, except for BC where it is a bit over 4 ACH.)It is expected that any new requirement may initially be fairly lenient to allow the industry to go through the learning process of how to build air-tight construction. After a few years it is likely that the standards will be made tougher.

Since the majority of UK housing is built to the minimum requirements of the codes, the changes, if implemented, will represent a significant improvement to housing standards. There is now a growing desire in the UK to improve quality in housing and a feeling that this is essential.

The industry is waiting for the first draft of the proposed new regulations, which should be published later in 1999. This will be followed by a further consultation process. It is expected that the regulations will come into force in early 2001. It is also possible that there may be a staged adoption of progressively tougher standards. ☼

Do Our Residential Mechanical Ventilation Standards Make Sense?

Gary Proskiw, P.Eng.
Proskiw Engineering Ltd,
Winnipeg

One of the great things about Solplan Review is that it provides an excellent forum for the exchange of opinions on building science issues. So permit me to do just that - offer a few opinions about residential mechanical ventilation standards. My concern is that the current standards may have some serious, perhaps even fatal, flaws which will seriously inhibit their effectiveness and value. Let me explain.

Canada has three different standards governing the design and installation of ventilation systems (with some provinces using their own variations). The oldest is CSA F326 "Residential Mechanical Ventilation Systems" which is referenced by the R-2000 Program and, more recently, by the 1995 National Building Code (NBC). It is generally regarded as complex, difficult to understand but capable, in theory, of providing a good quality ventilation system. The second standard in common use is the prescriptive component of Section 9.32 of the 1995 NBC, which was developed at the request of the Canadian Home Builders Association in an attempt to achieve the general intent of CSA F326, but without its complications and difficulty. Both CSA F326 and Section 9.32 have their limitations and have received a lot of criticism. To be fair, much of this criticism has dealt with relatively minor details or has resulted from lack of training or workmanship problems (all of which are solvable).

However, there are some fundamental weaknesses with both these standards that cannot be solved with minor tweaking or better training. Let us consider them before exploring the third option for ventilation standards.

The Depressurization Dilemma

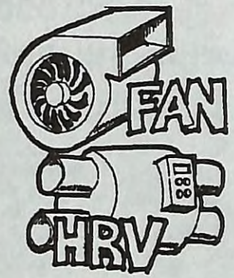
Perhaps the biggest problem with both CSA F326 and Section 9.32 is their treatment of excessive depressurization in houses containing spillage-susceptible appliances. The problem is that most of these devices will spill at very low indoor-to-outdoor pressure differentials (for example, at about 5 Pascals for a naturally aspirated appliance). Both CSA F326 and Section 9.32 require make-up air to be introduced in houses with spillage-susceptible appliances. CSA F326 permits either a passive make-up air vent (a hole in the wall) or a powered make-up air (one that uses a blower to introduce the outdoor air) while Section 9.32 requires a powered make-up air. In theory, either will work - at least in calm wind conditions.

From my perspective the biggest problem with these systems is this: will the homeowner defeat them by plugging the duct or disconnecting the make-up air fan? How many people will leave a 6", 8" or 10" hole open in the side of their house once winter sets in and they can feel the wind howling through the basement? Sure, warning labels can be put on the ducts or fans and people can be advised not to obstruct them - but is this realistic? Once the make-up air system is defeated, the house is vulnerable to combustion spillage and all the health and safety risks which that creates.

To complicate matters further, there is debate and confusion about what conditions should be used to determine the depressurization limit. CSA F326 and Section 9.32 use somewhat different approaches, neither of which is consistent with the Gas Code (CGA B149), which calls up a more rigorous test condition (i.e. with all exhaust appliances operating). In addition, there is the issue of high-capacity exhaust devices which are not part of the ventilation system. Recent experience is showing that many new houses built to the 1995 NBC will fail the depressurization requirements of the Gas Code simply due to the presence of a clothes dryer. Elaborate make-up air solutions can be implemented (such as interlocking exhaust devices and using preheaters to temper the outdoor air), but these are complicated and expensive. They may also require the use of elaborate and failure-prone control systems. Often eliminating the spillage-susceptible appliances may actually be less expensive than to add a make-up air system.

The Utilization Issue

The purpose of any ventilation system is to exhaust pollutants and supply outdoor air. This dictates that the system must be used on a reasonably consistent basis. What happens if the homeowners do not use the system because they believe it wastes energy, creates cold drafts or induces other problems? Obviously, the air quality will be compromised.



Ten years ago, as part of the Flair Homes Energy Demo Project, we monitored the use of ventilation systems over a three-year period. In houses with Heat Recovery Ventilators (HRVs), ventilation systems were operated by the homeowners an average of 19 hours/day (80% of the time). However, in houses with central exhaust systems (with the same flow capacity as the HRVs and with relatively quiet blowers), the systems were used an average of 37 minutes/day (less than 3% of the time). Guess which houses had the better air quality?

I think the main reason for these use patterns was that the people with HRVs figured out they could ventilate without a huge impact on their energy bills or comfort. In contrast, those people with central exhaust systems realized that every time the blower went on, their utility bills would skyrocket. Other researchers have reported similar results. Although the technology has improved in the last decade, neither CSA F326 nor Section 9.32 require heat recovery. Thus, there is a strong possibility they may suffer the same utilization problems experienced by the central exhaust systems in the Flair Project. (I would love to see some utilization monitoring of current ventilation systems).

Again, we can take the attitude that building codes cannot legislate how people live in houses. However, this is unfair and a bit of a cop-out. The behaviour of people is relatively predictable and we have to design solutions that have a reasonable chance of being used. I am not sure we have achieved that with either CSA F326 or Section 9.32.

Furnace Mixed Air Temperatures

Both CSA F326 and Section 9.32 require supply air (i.e., outdoor air) to be introduced into the house and distributed to the bedrooms and some of the other rooms. For houses with forced air heating systems, the furnace ductwork is the logical means for distributing the outdoor air. However, if the air is not tempered, it can create thermal shock, condensation and corrosion problems with the furnace heat exchanger. A controlled amount of outdoor air can be mixed with the furnace return air to provide an acceptable mixed air temperature. However, this is easier said than done and achieving, and maintaining this delicate balance can be tricky. Further, chilling the return air with outdoor air can create comfort problems that may further impede the homeowner's use of the system.

So, What is the Answer?

While CSA F326 and Section 9.32 are acknowledged as ventilation system options, there is actually a third alternative in widespread use, although it is not normally recognized as such. This is the "R-2000 ventilation system." Ventilation systems used in R-2000 houses must comply with CSA F326, but they must also have a couple of other features that set them apart from both CSA F326 and Section 9.32 systems. First, all R-2000 houses have HRVs - not because they are formally required but so the house can meet the R-2000 Energy Target. Second, the R-2000 Program does not permit spillage-susceptible combustion appliances to be used for the space or water heating systems and places restrictions on the type of wood-burning appliances that can be used. Based on extensive monitoring, we know for the most part that "R-2000 ventilation systems" *do work.* People use them; they are reliable; air quality is good; and health and safety problems are kept to a minimum.

So, what can we learn from this?

Lesson #1: Eliminate Spillage-Susceptible Appliances

If the R-2000 experience with more than 8000 houses is any indication, the only workable solution to the depressurization problem is the elimination of spillage-susceptible appliances. Conventional make-up air systems just invite homeowner intervention. Nobody has invented a magic make-up air box that works reliably and safely - and costs less than replacing spillage-susceptible appliances with non-spillage susceptible types. Also, since non-spillage susceptible appliances are usually higher efficiency devices, there use will also provide energy savings and reduced greenhouse gas emissions.

Lesson #2: Heat Recovery Must Be Included As Part of The Ventilation System

If we expect homeowners to operate their ventilation systems on a consistent basis, heat recovery must be included. Otherwise, the energy penalty and comfort problems will ultimately deter people from using the systems. Heat recovery also provides a reliable solution to the furnace mixed air temperature problem.

The Future

Here is my prediction for the future of Canadian housing.

Ten years from now, only non-spillage susceptible combustion appliances will be used in new houses. Remember what happened with naturally aspirated furnaces? Expect the same to occur with hot water heaters and other appliances. Second, all new houses will be built with some type of heat recovery on their ventilation systems thereby making it practical for them to be used on a continuous basis, no matter the time of year. ☼

Attention Earthship, Earthpod builders and promoters
Wanted: Details of Working Earth Integrated Homes

There is a lot of interest in earth-integrated homes. How well they really work is speculative. Proponents often make outlandish claims, while engineering principles suggest they cannot possibly work that way. Is there something that engineering knowledge is missing, or is it a question of lifestyles?

Bion Howard, an environmental building consultant based in Maryland USA, would like to investigate projects built using these technologies. He is proposing to do an energy evaluation, and review the projects with their builders and owners. This professional analysis will be done at no cost, but builders and owners must agree to allow the results to be published, although privacy and proprietary information will be respected. Plans, material specs, and climate/location information is needed for built examples. Construction videos, utility billing data, owner statements, and contact information will also be helpful.

If you have been involved in such a project, or have an associate who has, contact

Bion Howard
Earth-integrated Building Tech Review
Building Environmental Science & Technology
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e-mail: bdhoward@ix.netcom.com

Deadline for submissions: August 25, 1999.

Changes to R-2000 Technical Requirements

The R-2000 Technical Requirements set out criteria that must be met to certify homes under the program. Like the building code, the requirements are reviewed and adjusted periodically to reflect state-of-the-art housing technology for energy efficiency and environmental responsibility. The latest review has just been done.

Some proposed changes are editorial and administrative. Some will reduce the cost of R-2000 construction either directly (by making it easier to reach the energy target) or indirectly (by lowering some administrative costs). Others are more substantive. It is also important to recognize that not all the changes will apply to every house.

Changes That Have No Significant Impact on Cost

As well as editorial and administrative changes, these include:

- Requirements that natural **gas and propane fireplaces** must be direct vent, forced draft or induced draft.
- Formal inclusion of the requirements for **masonry fireplaces** (added as supplemental measures post-1994).
- Updating of the **indoor air quality and eco-management pick-lists**. These have also been moved to a separate document, which will permit the items on the list to be easily updated as new products, systems and designs become available, and make it easier to add options that may only be available in certain regions of the country. The number of options on the pick-list will be expanded from the current eight. However, the minimum number of options the builder has to select will remain at two.

Changes to Prescriptive Requirements That Produce Offsetting Performance Savings

Some proposed changes have a significant impact. **Window performance requirements** have been upgraded. Minimum criteria (ER - energy ratings) depend on the climate (heating degree-days). As not all manufacturers have their products labelled using the ER system, several generic descriptions of acceptable windows will be provided.

A new requirement has been added which mandates that **basement wall insulation** must be installed down to the basement floor without any reduction in its RSI value.

Degree Day Zone (DDC)	Minimum Energy Rating (ER)	
	Operable or fixed glazing with sash	Fixed glazing without sash
up to 3500	-18	-10
3501 and over	-10	0

While these requirements result in an increase in the construction cost, the improved energy performance makes it easier, and cheaper, for the rest of the house to meet the energy target. For example, by using higher performance windows other energy-related measure(s) can be deleted from the house which offsets the cost of the better windows.

Changes That Reduce Construction Costs

Some changes will actually reduce the cost of R-2000 construction either directly (by making it easier to reach the energy target) or indirectly (by lowering some administrative costs which builders have to pay).

Changes will also be made within HOT 2000 to use operating schedules that more accurately reflect how homeowners actually use **mechanical ventilation** systems and forced air heating systems (where the latter are also used to distribute the ventilation air). Lower mechanical air change rates will be allowed to be used in the HOT 2000 analysis thus making it easier to reach the energy target.

A new **Pre-Approval Method** will eliminate the need for doing many HOT 2000 analyses when a group of similar house designs is used in a location. This will allow builders to design their R-2000 upgrade packages and establish the incremental costs well ahead of closing the sale.

Airtightness requirements are unchanged but the builder can select any level of airtightness between 1.0 AC/hr50 and 1.5 AC/hr50 for design purposes - which must of course be met during the airtightness test.

Changes That May Increase Construction Costs

Some proposed changes may increase construction costs without any corresponding savings.

A significant health and safety change is that **carbon monoxide detectors** are now required in any house that contains a combustion appliance, whether wood, gas or oil fired; and in any house

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

that has an attached garage. The reason behind this is that any type of combustion device is potentially able to suffer from combustion spillage. The attached garage requirement recognizes that if the wall separating the house and garage is not airtight, poisonous car exhaust fumes can be drawn into the house even if the garage door is open.

A requirement has been added for **proper sizing of heating and cooling systems** (according to CSA F280), and that properly trained individuals be used to design forced air distribution systems. The 1995 National Building Code (NBC) requires compliance with CSA F280, so it may already be met in some jurisdictions. As well, heating and cooling systems must be commissioned to ensure the final product performs as designed.

Another important change is that a requirement has been added for **energy efficient air distribution systems** (e.g., electronically commutated furnace motors) in those situations where a forced air heating system is used to distribute ventilation air (a common practice in R-2000 houses). This requirement will be staged in over time to allow the industry to adapt, and the exact dates will be negotiated.

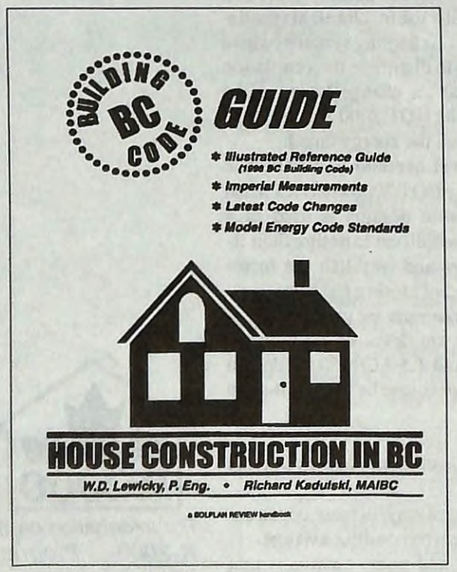
Water heater requirements now require improved performance standards for natural gas, propane and electric domestic hot water heaters. The intent is to maintain a central registry of tank models that meet R-2000 requirements.

Co-venting of spillage susceptible combustion appliances will now be prohibited.

Toilets will now be required to use no more than 6 litres/flush.

Since the last revision of the Technical Requirements, the 1995 National Building Code has come into effect which introduces new requirements for mechanical ventilation systems. These increase the cost of a conventional house by $500 to $1000, but do not affect the cost of an R-2000 house. Thus, the average cost differential between an R-2000 house and a conventional, equivalent home should actually decrease.

The date the new requirements come into effect has not yet been set. It should be later this year. ☼


BUILDING BC CODE GUIDE
* Illustrated Reference Guide (1998 BC Building Code)
* Imperial Measurements
* Latest Code Changes
* Model Energy Code Standards
HOUSE CONSTRUCTION IN BC
W.D. Lewicky, P. Eng. • Richard Kadulski, MAIBC
a SOLPLAN REVIEW handbook

A Simplified, Illustrated Guide to Residential Construction in BC

House Construction in BC

by W.D. Lewicky, P. Eng. and Richard Kadulski, MAIBC

The illustrated guide to the 1998 BC Building Code explains Part 9 of the code as it applies to residential construction. This reference guide uses imperial measurements and explains code requirements with sketches where appropriate. The guide highlights the new code changes that came into effect on December 18, 1998.

Editorial comments are made to show where better practice can avoid problems, especially with building envelope detailing.

Also includes highlights of Model National Energy Code for Houses requirements for BC. (These standards are currently optional).

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Technical Research Committee News

Canadian Home Builders' Association

Plastic fittings

We have received reports of failures in CPVC plastic plumbing fittings. The problem seems to be one of joint failures in hot water plumbing systems. In at least one case, it was improper installation: a brass fitting was coupled to a CPVC fitting despite manufacturer's instructions not to do so. (The difference in thermal expansion was enough to put pressure on the plastic fitting and crack it.)

However, in several other cases, it was a joint failure in the CPVC components. An investigation is being done to find out if it was a failure in the adhesive used, an installation fault such as adhesive setting before the fitting was coupled, inadequate preparation of the joint, or perhaps a fundamental problem in the materials themselves. If anyone has encountered similar problems with CPVC plastic plumbing fittings, please let us know with as many installation details as are available.

Polyethylene Vapour Barriers

Many building envelope problems experienced in BC are being blamed on the use of polyethylene. This despite all the evidence that points to moisture problems in the envelope being caused by exterior moisture finding its way into the building envelope. Some say the mere presence of polyethylene contributes to moisture accumulation, and want to see requiring it removed. Perhaps, a misunderstanding of the principles involved is leading to the confusion.

Vapour barriers must be used to avoid the diffusion of moisture through the construction. Vapour barriers are important, and must be placed on the interior (warm side) to reduce diffusion.

At the same time, an effective *air barrier* reduces the pressures acting on the building envelope. It has been determined that air movement through the building envelope is the major driving force that moves moisture into the construction. That means the air barrier must be continuous, while the continuity of the vapour barrier (in the presence of an effective air barrier) is less important.

The code requires vapour diffusion be contained, and that the building envelope minimize air movement through it. That is why the code maintains a requirement for a *vapour barrier* (or vapour diffusion retarder with a permeance not more than 45 ng/Pa.m²s. Only if a low permeance siding material is used, a lower permeance interior vapour has to be used) and an *air barrier. These are two distinct functions* that are often confused. The code does not explicitly state how vapour diffusion and air barriers are to be built. The same material may provide both functions, or different materials may do the job.

Polyethylene was used as both an air and vapour barrier in much of the work that was done in Saskatchewan in the 1960's and 1970's. In the cold dry Saskatchewan climate, the vapour pressure is much greater than it is in a mild moist climate, so the quality of the vapour diffusion retarder is more important. Given the materials available and the understanding of building science at the time, the poly was a convenient material to use. As a result, polyethylene was adopted as the only material to use for a vapour barrier.

Polyethylene has an extremely low permeability and is almost a perfect barrier (3.4 ng/Pa.m²s for 6 mil poly). However, under some circumstances (especially with low vapour pressure differences), some permeability is acceptable, so less than perfect barriers, such as low permeance paint (26 ng/Pa.m²s), asphalt kraft paper (17 ng/Pa.m²s), and 1" thick high density extruded polystyrene insulation (44 ng/Pa.m²s) may also be used.

The TRC will be examining if the standard needs to be revisited. Anyone with an opinion or concern is invited to contact Gary Sharp at the CHBA office.

New R-2000 Program Manager

Tim Mayo has been named manager of the R-2000 Program. He replaces Gisele Maillet, who has taken a leave for personal reasons. Tim is well known as the program manager of the successful Advanced Houses program that finished a few years ago. Most recently, Tim implemented the start of the Canadian Housing Technology Centre at the National Research Council. His nomination is a clear sign of the government's commitment to the R-2000 Program.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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Energy Efficiency and Climate Protection Can Be Profitable

Richard Kadulski

If we are going to come to grips with our environmental problems, we have to improve energy and resource efficiency in all our activities. Alternatives have to be looked at with a fresh creative viewpoint. The challenge is immense. We have to recognize that just "meeting code" is not good enough. It is also a waste of money.

Problem solving has to be creative. "Rearranging our mental furniture is the first step in achieving improvements that will dramatically reduce energy use," U.S. energy pioneer Amory Lovins told participants at Canada's Energy Efficiency conference in Ottawa last May.

We have created a system that discourages efficiency . . .

Lovins pointed out that significant economic gains are to be made through energy efficiency and greenhouse gas reductions. In the U.S. alone, the waste heat generated by electric power plants equals the energy used for all other purposes. The Canadian situation will not be significantly different in areas that rely on thermally generated electricity.

The big prize is end-use efficiency. There is a huge opportunity to "use less energy, less money and more brains to get more services."

A major challenge we face is the way we, and financial people in general, look at the world. Marginal costing for insulation, wiring, piping and other components reflects the present value of fuel, but not the capital cost of the total system. Usually we just optimize a single component like thermal insulation by itself, and ignore the rest of the building. A life cycle comparison that counts all the system's capital and operating costs is rarely done.

All parties in the real-estate value chain are systematically rewarded for inefficiency and penalized for efficiency . . .

We have created a system that actually discourages efficiency. One person may choose the technology, and someone else buys and uses the energy. Design professionals get paid according to what they spend, not what they save. All other parties in the real-estate value chain are also systematically rewarded for inefficiency and penalized for efficiency because each gets a percentage of cost. The impact of incentives or information is often lost, because it does not affect those making decisions.

Markets work if allowed to. However, experience suggests that until we reward people for saving something (or even for thinking about how to), they have no reason to do it, so initial cost projections will be grossly exaggerated. The phase-out of leaded gasoline and CFCs were predicted to be catastrophic to the economy, but turned out to cost little (or nothing). .

Because energy is so cheap today, it gets little attention. Most purchases that affect energy use are based solely on initial cost. For example, thicker office wiring isn't purchased because it is not the cheapest. However, heavier wire reduces resistance, making the electrical service more efficient, and permanently reducing operating costs.

The builder chooses the heating system, usually the cheapest hardware available. However, the buyer or tenant has to pay for the ongoing operation and maintenance - which is often more expensive than alternatives rejected because of initial cost.

However, let us not forget that not only price influences behaviour. Public concern, political leadership, corporate competition, and fashions also play a role. Energy efficiency and distributed resources will increasingly be bought for reasons other than just saving commodity cost. Superior service quality and distributed benefits are just two, but they are not considered in conventional economic tools.

Principles of profitable climate protection

The objective is to reduce and eventually reverse the climate change we have started. If we make an honest analysis, we will find that displacing carbon fuels and using energy efficiently is not costly and can be profitable. Saving fossil fuel costs less than buying it (ignoring environmental benefits of not burning it).

In the U.S., the waste heat produced by thermal power plants equals Japan's total energy use because only 34% of the emissions fuel is converted to useful work. In Denmark the average conversion is 61%. Overall system efficiencies of 90% are achievable, which could cut U.S. $C0_2$ production by 23%. ($C0_2$ is the main greenhouse gas responsible for climate changes).

We must be concerned because buildings account for 1/3 of all the CO_2 generated. $C0_2$ generation could be reduced by more than two thirds using cost-effective retrofits, or even by 75-90% in new construction. Lovins uses as an example a 19,000 m² office building in Chicago renovated using new high performance curtain wall elements at the same cost as a standard renovation, but was capable of achieving 75% energy reduction, drastically reducing the size of the mechanical systems needed to condition the building.

The Canadian Advanced houses showed that new houses can be built and maintained comfortably with minimal or no heating/cooling equipment. Even building to R-2000 standards would go along way to improving the situation. However, it does require the willingness to consider and implement the options.

Big savings may often cost less than small savings. Lovins provides another example in an industrial setting. Carpet maker Interface discovered they could cut pumping energy in a new Shanghai factory from the "optimized" 70.8 kW to 5.3 kW (a reduction of 92%), and cut the first cost too simply by using big pipes and small pumps, rather than small pipes and big pumps that are the standard approach in industrial design. As well, they laid out the pipes first so they could be kept short and straight before hooking them up to the pumps. This strategy also allowed more insulation, adding an extra saving 70 kW of heat. Nothing exotic - just good whole-system engineering.

Another terribly inefficient example closer to home is our automobile. Cars today use only 1% of their fuel energy to move the vehicle and driver. However, major changes are coming here. A new emerging technology is the fuel cell. Unlike conventional boilers or engines that rely on combustion to generate energy, fuel cells have no moving parts, but rely on a chemical reaction.

Fuel cells can turn 50% of hydrogen's energy into electricity and pure hot water (ideal for heating, cooling, and dehumidifying buildings). The source of hydrogen is often natural gas, which is broken down in the fuel cell.

In future, large commercial or multifamily projects may be heated and cooled by fuel cells. The fuel expenses will thus be covered by the building services. However, the electricity generated by the fuel cells will be a bonus, cheap enough to undercut the operating cost of existing coal and nuclear power stations, let alone the extra cost to deliver their power (which in 1996 averaged 2.4 cents per kilowatt-hour).

Many readers will have heard of Ballard Power, a Vancouver-based company that has been pioneering the development of fuel cells. Their thrust so far has largely been oriented toward automobile power (cars and buses). However, several other companies are also active in the field, and some are about to market packaged, natural-gas-fuelled fuel cell cogeneration systems. Some will be household-scale.

Although fuel cells are still expensive, there is little doubt that there will be dramatic price reductions. Once fuel cells become cost-effective and are installed in a car, the vehicle becomes more than just a car. It is also, in effect, a clean, silent, reliable power station on wheels, with a generating capacity of at least 20 kilowatts.

Think of the potential. The average car is parked about 96% of the time, usually in the same places. Suppose you pay an annual lease fee of about $4,000 - 5,000 for the privilege of driving your "power plant" the other 4% of the time. For the rest of the time, rather than plugging your parked car into the electric grid to recharge it (as battery cars require) you plug it in as a generating asset and collect a royalty from the power company. While you are at work, your power-plant-on-wheels is sending 20+ kilowatts of premium-quality electricity back to the grid.

If a modest number of drivers took advantage of this deal on a consistent basis, most or all existing coal and nuclear power plants could, in principle, be displaced because the fleet could have many times the generating capacity of the national grid. ☼

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R-2000 File Management
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Energy Answers

Rob Dumont

How long does it take to recover the embodied energy in insulation? In other words, if you put a very large amount of insulation into a building, does the extra energy embodied in the insulation take a long time to recover through reduced heating energy consumption?

Let us take an extreme example. Our house in Saskatoon has an attic insulation level of R80–two feet of cellulose insulation. In this part of Canada typical attic insulation levels in new homes are about R35. Thus the extra insulation we have is R45. The embodied energy in a square foot of R45 loose fill insulation is 25,700 BTU (without data for the embodied energy of cellulose fibre insulation, I will use the value for mineral wool insulation. The embodied energy of cellulose fibre insulation is likely much less than the value for mineral wool insulation; so the analysis is erring on the conservative side.)

On an annual basis, that extra R45 of insulation in our house saves 4,200 BTU per square foot in Saskatoon compared with an attic insulated to R35. Thus the extra investment of 25,725 BTU per square foot in insulation saves 4,200 BTU per square foot of energy each year, and the energy payback period is 6.1 years. For a house that has an expected life of a century or more, an energy payback of 6.1 years is quite reasonable on the extra insulation used, especially considering the very high extra insulation levels used in our house compared with conventional houses.

Insulation, besides being cost effective, also has a relatively short energy payback even when very large amounts of insulation are used. An added benefit of extra insulation is the sound attenuation associated with the insulation. Recently many homes near the Minneapolis airport were successfully weatherized to reduce the noise transmission from the aircraft.

With extra insulation in walls, the energy payback is longer, because you have to build a structure to house the extra insulation. In our house, we used double 2x4 stud walls to get the thickness to incorporate R60 blown-in cellulose in the walls. The extra embodied energy associated with these walls has to be considered, along with the extra foundation area, roof, etc. to hold the extra insulation.

Energy Embodied in Typical Building Materials
(Embodied energy before delivery to job site)

Building Material	Embodied Energy BTU/pound	Value compared with Aluminum
Aluminum Structural Shapes	90,900	1.0
Stainless steel sheets - cold rolled	131,000	1.4
Stainless steel wire	228,000	2.5

What is the worst building material for embodied energy? Can anything beat aluminum for high embodied energy?

Yes.

The table shows some figures from an article by Stein and Serber (1979). The data developed by Stein and Serber is not a complete listing of all building materials, and other materials have even higher embodied energy values. As can be seen from the table, some types of stainless steel have even higher embodied energy values than aluminum.

Precious metals such as gold and platinum likely have much higher embodied energy, but they are not commonly used as building materials.

NRC·CNRC

Effect of Electrical Outlet Boxes on Sound Transmission through Gypsum Board Walls

By Trevor Nightingale

Recent research at NRC's Institute for Research in Construction has demonstrated the importance of proper placement of electrical outlet boxes when noise reduction, especially between dwelling units in multi-family buildings, is important.

The research showed that poorly placed outlet boxes can decrease the sound isolation of gypsum board walls by up to six sound transmission class (STC) points, when compared to walls with no boxes. It also showed how this degradation of performance can be minimized.

The Canadian Electrical Code requires all walls in a dwelling have a certain number of electrical outlet boxes per unit length of wall. The National Building Code of Canada (NBC) requires partition walls between units in multi-family dwellings to be both fire- and sound-rated. However, penetrations at electrical outlet boxes can degrade the sound isolation of a wall, reducing the acoustical privacy between units.

Until IRC researchers conducted a systematic study, the effect of such factors as the type and location of outlet boxes, and the presence of sound-absorbing material and its placement in the wall cavity were not well understood. The study also quantified the effectiveness of several practical retrofit methods to improve the sound isolation of walls with poorly located boxes.

This article reports on results for double-stud gypsum board walls, since this type of wall is most likely to be used to achieve a high degree of sound isolation between dwelling units.

Two types of electrical boxes are commonly used in multi-family dwellings: standard metal boxes for interior partitions and plastic vapour-barrier boxes for exterior walls. Table1 shows that acoustically these boxes perform very differently. Plastic vapour-barrier boxes had little impact on sound isolation regardless of their relative location while metal boxes led to a significant reduction in sound isolation, especially when the boxes were spaced closely.

This difference in performance is directly related to the relative airtightness of each type of box. Standard metal boxes have many holes to allow for electrical wires entering the box, and for the box to be fastened to the stud. In contrast, plastic vapour-barrier boxes have closed-cell foam gaskets which form an airtight seal where the wires enter the box and tabs on the outside of the box that are used to fasten the box to the stud, so there are no unsealed holes in the box. Plastic vapour-barrier boxes also typically have a backer plate at the mouth to seal the box to the gypsum board. These airtightness features impede the transmission of sound as well as the flow of air, and can compensate for problems caused by box proximity.

The effects of location of metal boxes and the presence and placement of sound-absorbing material (e.g., fibrous building insulation) were investigated using three different double-wall assemblies. One had no sound-absorbing material in the cavity; one had sound-absorbing material that was pushed aside so it did not cover the outlet box; and one had sound-absorbing material in the cavity completely covering the back of the outlet box. The effect of increasing the separation between the boxes on either side of the wall was investigated for each wall assembly.

Box type	STC		
	Reference Wall (no boxes)	Electrical Box Location: Boxes located back-to-back, no horizontal offset	Electrical Box Location: Boxes separated by at least one stud, 400-mm horizontal offset
Plastic vapour barrier	55	55	55
Metal	55	51	53

Table 1. Measured sound isolation expressed as an STC rating for metal outlet boxes and plastic vapour-barrier outlet boxes in the double-stud wall without sound-absorbing material in the cavity

It was found that the change in sound isolation depends upon several factors, including the separation, or horizontal offset, of the boxes, the construction of the wall assembly, and the placement of the sound-absorbing material in the cavity. The combined effect of metal box location and sound-absorbing material placement in the cavity of a gypsum board wall can be large. In the worst cases, the sound transmission class (STC) rating decreased by six points.

While these factors cannot be fully separated, it is possible to identify general trends.

The greatest reduction in STC occurred when there was a short direct path between boxes; that is, when the sound did not have to travel through sound-absorbing material or through the narrow gap between opposite studs into the adjacent stud cavity.

When the sound had to travel through material in the cavity, the presence of boxes had minimal effect.

Dr. Trevor Nightingale is an acoustics researcher in the Indoor Environment Program of the National Research Council's Institute for Research in Construction. Further details of this research can be found in IRC's Construction Technology Update series, available on subscription. See the notice and order form for this series in the previous issue of Solplan Review.

Very little reduction in STC was noted for walls with the electrical boxes located in an adjacent stud cavity and at least 400 mm apart. The presence of sound-absorbing material further ensured that the electrical boxes have a small effect on STC.

These trends broke down only when the boxes were within the same stud cavity and there was no sound-absorbing material.

For boxes located back-to-back, installing a layer of sound-absorbing material between them greatly improved the STC. Thus, where possible, the sound-absorbing material around the boxes should not be displaced because its effectiveness will be reduced.

Retrofit Measures

When an existing wall has decreased sound isolation because of improperly located electrical boxes, there are several possible remedies or treatments, all involving modifications in and around the outlet box.

A bead of caulk can be used to fill the gap between the box and the gypsum board. This simulates the flange and seal that form the airtight seal to the gypsum board in a plastic vapour-barrier box.

A simple draft stopper — a closed-cell foam gasket commonly sold in hardware stores — can be placed between the gypsum board and the faceplate covering the electrical outlet. They are easy to install, but improvement in sound isolation was found to be variable because an adequate seal cannot be formed if the gypsum board opening has been poorly cut or the box is skewed so it protrudes beyond the face of the gypsum board.

Electrical box inserts made from thin rubber or plastic reduce airflow if they are tightly fitted inside the box. The degree of airtightness, and resulting improvement to the sound isolation of the wall, is determined largely by how well the holes or slits for the electrical wires are sealed with caulking, and how well the insert is sealed to the gypsum board.

Lining the interior of an electrical box with a mastic material to make it airtight will increase the sound isolation of the wall, especially if the material can be sealed to the gypsum board. But a word of warning: While a wide range of materials, including caulking, can provide the necessary acoustical properties, it is possible that they may have other properties (such as electrical conductivity) that make them unsuitable for this use. Before installation, the local electrical authority should confirm the suitability of the material for placement in electrical boxes.

While the results show that electrical outlet boxes need not significantly affect the sound isolation of gypsum board walls, a companion preliminary study by IRC's Fire Risk Management Program showed that their presence may be of concern with respect to fire resistance.

In the absence of a more complete study, boxes in fire-rated walls should be avoided if possible; however, if boxes must be placed in the wall they should be spaced as far apart as possible.

Summary

The sound performance of a wall when related to electrical outlet boxes can be improved by observing some simple guidelines:

Ensure that (untreated) metal boxes are offset horizontally by 400 mm or more in adjacent stud cavities rather than placed within the same stud cavity; or

Use plastic vapour-barrier boxes; or

Use retrofit techniques that emulate the properties of plastic vapour-barrier boxes.

As well, remember that the presence of sound-absorbing material in the cavity helps to further minimize the effect of poorly located boxes, especially when installed so that the material blocks the line of sight between the boxes. ☼

States Buy Into Geothermal Heat Pumps

A growing number of states are providing financial incentives for the use of earth energy heat pumps, which the U.S. government considers to be one the most efficient heating and cooling technologies currently available.

The state programs include property tax exemptions for installed units, income tax credits, and grant programs for public-private geothermal energy projects.

Credit Where It's Due

In the March 1999 issue (Solplan Review No. 85) we had a story on polybutylene (Poly-B) plumbing. In the editing process we neglected to mention that it was based largely on a news release written by Brent Applegate and issued by the Prairie office of the Canadian Association of Home Inspectors.

Did You Know?

The average Canadian household consumes about 20 to 24 GJ of natural gas for domestic hot water heating alone, which translates to a carbon dioxide production of 980 to 1170 kg (2160 to 2590 pounds), or more depending on the efficiency of fuel combustion (natural gas is the cleanest of all fossil fuels). Add to this the fuel used for space heating, automobiles, decorative uses (such as fireplaces and torches) and you see that a single household produces large quantities of CO_2.

Our ever increasing combustion of fuels is raising the CO_2 levels in the atmosphere and contributing to global climate change.

In nature, CO_2 is taken in by plants, and converted into plant material. If you want to know what is needed to take up the CO_2 produced by fuel combustion, you need to know that the average tree captures about 10 pounds of carbon dioxide per year. The rate will vary significantly (as much as 50 pounds, or as little as 5 pounds) depending on the climate, type of tree, soil conditions, etc. Thus, you need 216 to 260 trees just to take up the gases generated for heating domestic hot water!

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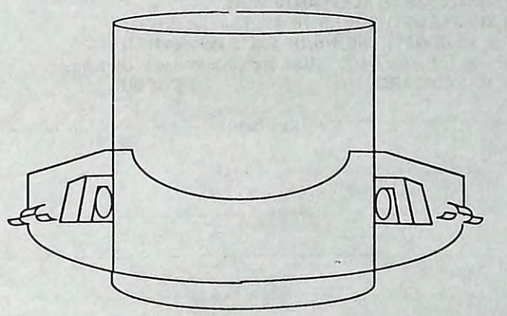

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Fax: 416-695-0450
www.ciph.com/ciphex/

Oct. 29, 1999
Housing Issues Conference (CHBA-BC)
Vancouver, BC
Tel: 604-432-7112
Fax: 604-432-9038
www.chbabc.org

Jan 19-20, 2000
Ontario Building & Renovation Forum
Toronto, ON
Tel: 416-447-0077
Fax: 416-443-9982

Jan. 23-23, 2000
Interior Design Show
Toronto, ON
Tel: 416-599-3222
Fax: 416-599-3224
www.interiordesignshow.com

April 3-8, 2000
Affordable Comfort Conference
Columbus, Ohio
Tel: 800-344-4866
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Apr 7-8, 2000
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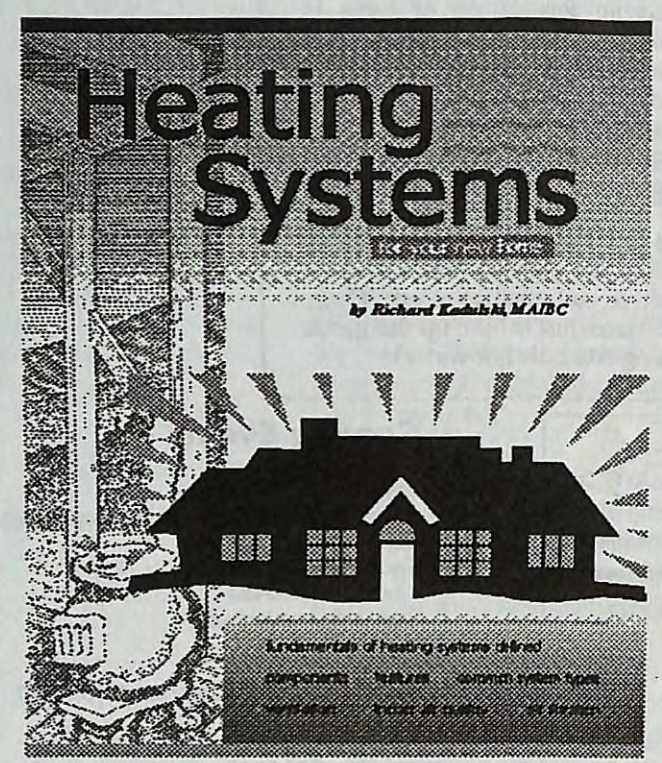

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